Summary of CNEC and CVT Year One Measurement Campaigns

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Consortia overview

- All NA-22 university funding is now devoted to 3 large consortia.
  - Each of the 3 consortia are comprised of several universities and laboratories (described in detail in the following slides).
  - Each consortium has a funding level of ~5 million per year for 5 years.

CNEC | Consortium for Nonproliferation Enabling Capabilities

CNEC Lead: NCSU

CVT Lead: University of Michigan

Nuclear Science and Security Consortium

NSSC Lead: University of California, Berkley

CNEC overview

- **Consortium for Non-Proliferation Enabling Capabilities (CNEC)**
- Vision: create a preeminent research & education hub dedicated to the development of enabling technologies and technical talent for meeting the present and future grand challenges of nuclear nonproliferation.
- CNEC thrust areas:
  - Identify and exploit signatures and observables (S&O) associated with SNM production, storage, and movement
  - Develop simulation, analysis, and modeling (SAM) methods to identify and characterize SNM and facilities processing SNM
  - Apply multi-source data fusion and analytic techniques (DFAT) to detect nuclear proliferation activities
  - Develop viable replacements for potentially dangerous industrial and medical radiological sources (RDRS).
- https://www.cnec.ncsu.edu/

CNEC overview

National Nuclear Security Administration

CNEC | Consortium for Nonproliferation Enabling Capabilities

Universities

NC STATE UNIVERSITY

University of Michigan

Georgia Institute of Technology

University of Illinois at Urbana-Champaign

North Carolina A&T State University

K-State Kansas State University

Purdue University

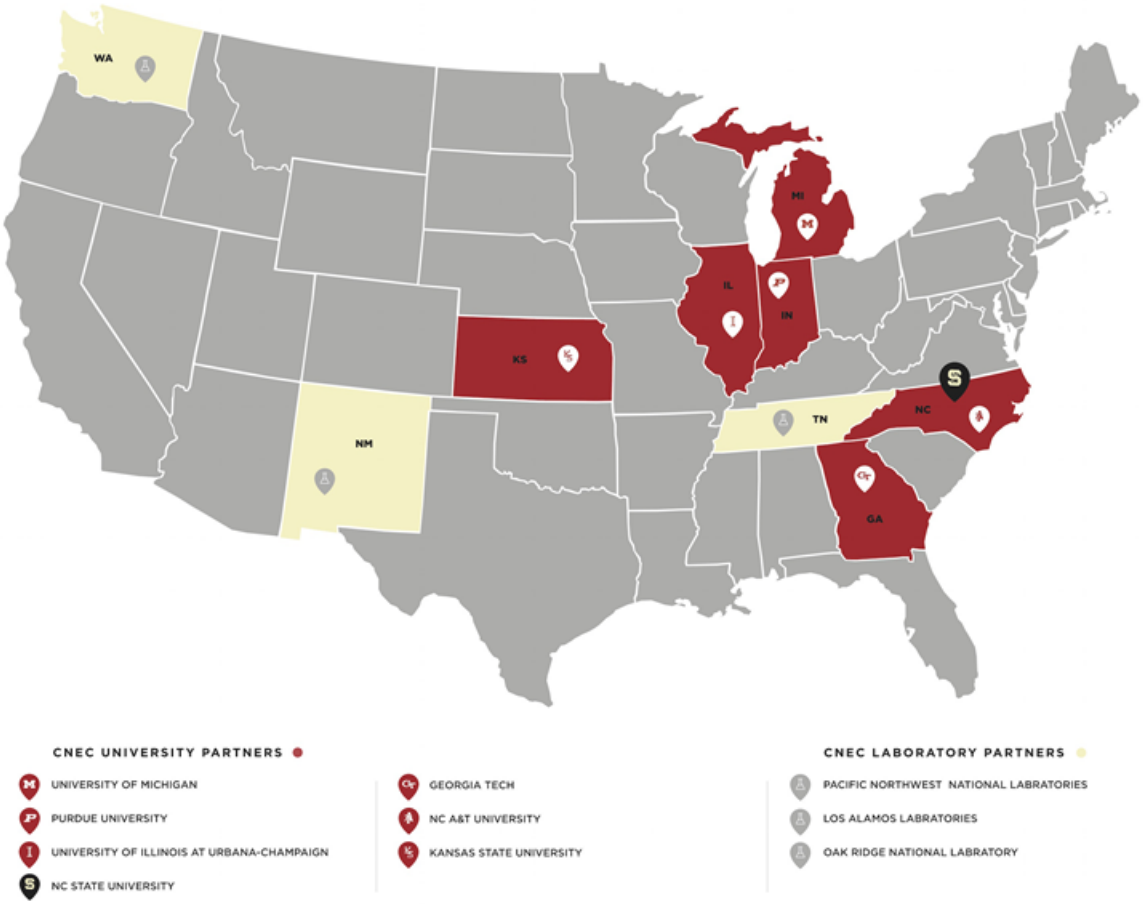
Laboratories

Los Alamos National Laboratory EST. 1943

Oak Ridge National Laboratory

Pacific Northwest National Laboratory

CNEC overview



CVT overview

- **Consortium for Verification Technology (CVT)**
- The scope of this consortium covers research and development to understand physical phenomenology through systems level analytics that lead to improved nuclear safeguards effectiveness as well as the core technology and methods to improve the ability of the US Government to verify nuclear arms control treaty obligations.
- CVT thrust areas:
  - Treaty verification: characterizing existing gaps and emerging challenges
  - Fundamental data and techniques
  - Advanced safeguards tools for accessible facilities
  - Detection of undeclared activities and inaccessible facilities
  - Disarmament verification
  - Education and outreach
- http://cvt.engin.umich.edu/

CVT overview

National Nuclear Security Administration

Universities

University of Michigan

The University of Wisconsin Madison

Illinois — University of Illinois at Urbana-Champaign

PennState

Princeton University

OSU Oregon State University

Columbia University

Duke University

UF University of Florida

University of Hawai'i

NC State University

Yale

MIT

Laboratories

Los Alamos National Laboratory — Est. 1943

Oak Ridge National Laboratory

Pacific Northwest National Laboratory

INL Idaho National Laboratory

Lawrence Livermore National Laboratory

Sandia National Laboratories

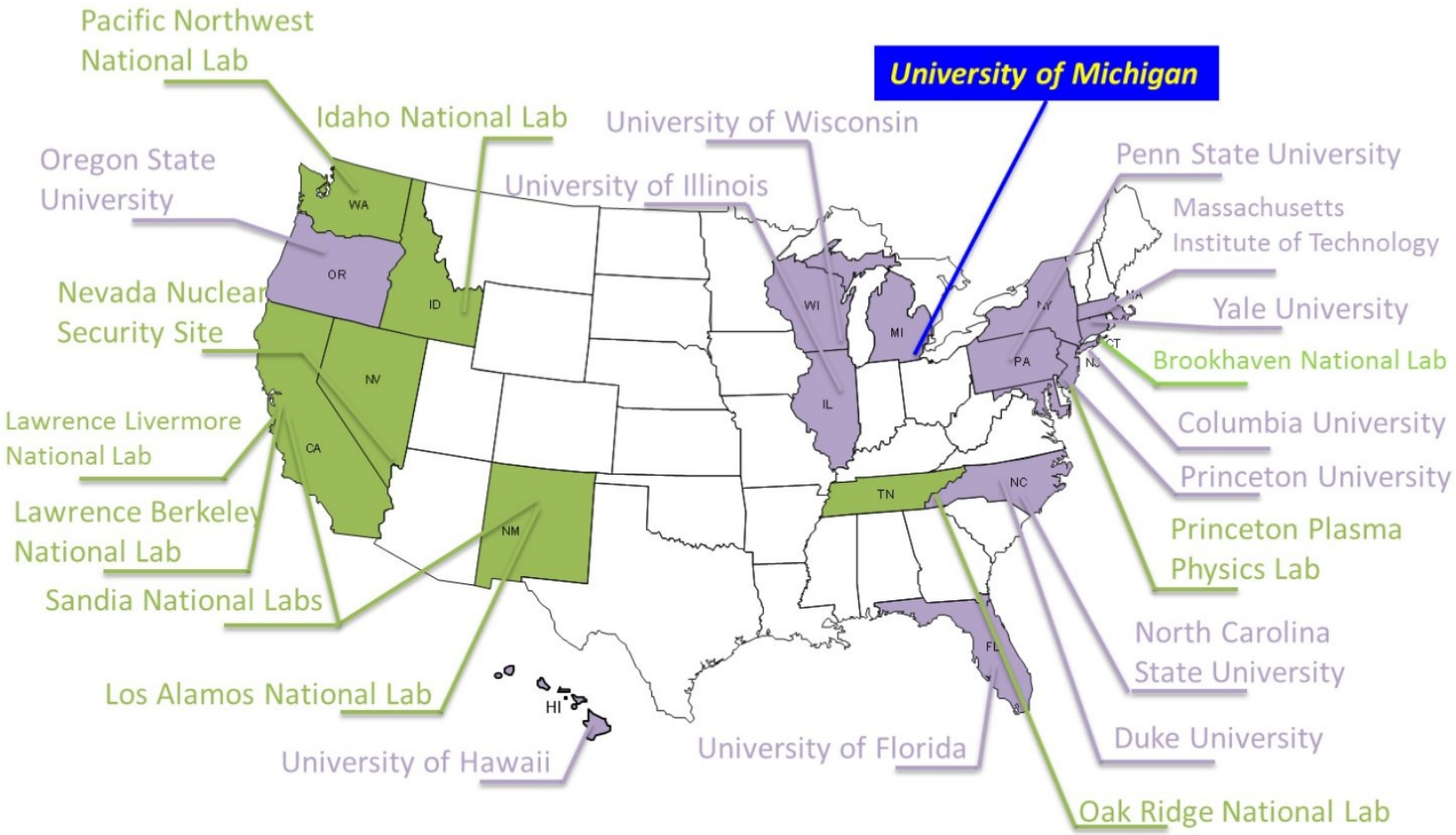
Berkeley Lab — Bringing Science Solutions to the World

PPPL Princeton Plasma Physics Laboratory

Brookhaven National Laboratory

Los Alamos National Laboratory — Est. 1943

CVT overview

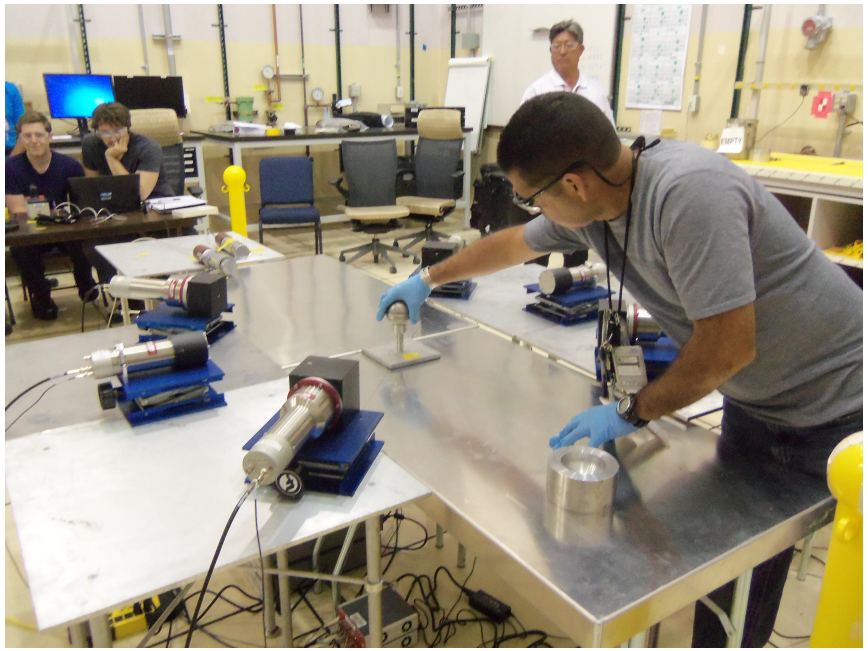


NCERC involvement

- The consortia project descriptions include:
  - “Provide students with a one-of-a-kind experience conducting subcritical experiments with Category I special nuclear material (SNM) at the Nevada National Security Site (NNSS).”
  - The consortia “will conduct annual experiments with Cat I SNM at the Nevada National Security Site (NNSS).”
- Planning for the year one measurements began on Oct 1, 2014.
- The universities submitted an experiment plan to LANL in December 2014/ January 2015.
- Measurements were performed during the weeks of June 29 and July 6 2015.

CNEC measurement campaign

- June 29 – July 02 2015.
- Included students and professors from NCSU, UIUC, UM, and Purdue.
- The following detector systems were used:
  - EJ-309 and EJ-299 scintillator system
  - 2”x2” NaI
  - 2”x2” $CeBr_3$
  - CsI handheld detector
  - GR-135
  - NPOD (provided by LANL)
  - ~140% HPGe (provided by LANL)



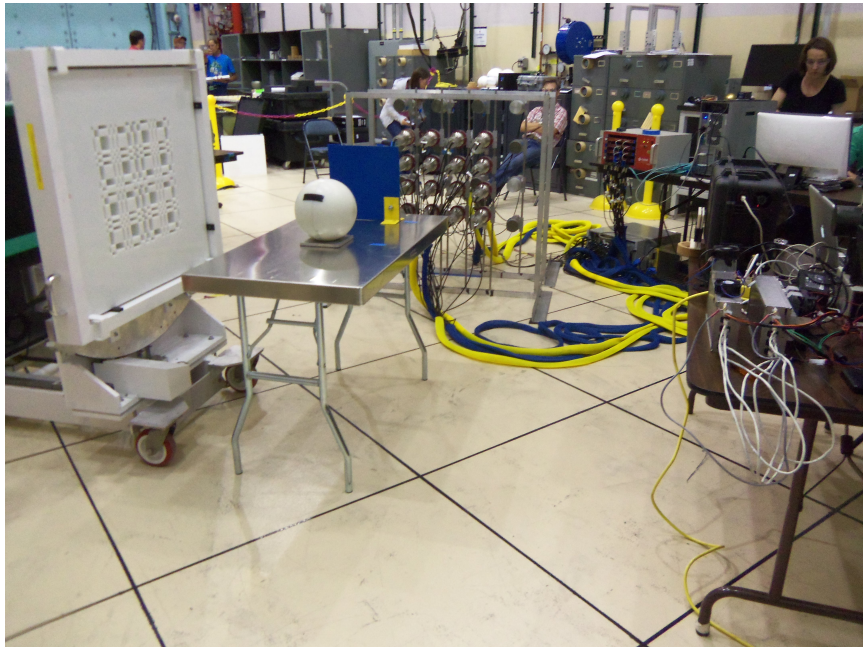
CNEC measurement campaign

- 9 configurations were measured:
  - Bare BeRP ball (4.5 kg α-phase Pu sphere)
  - BeRP ball reflected with 1” Fe
  - BeRP ball reflected with 0.5” W
  - BeRP ball reflected with 2 cm HDPE
  - BeRP ball reflected with 4 cm HDPE
  - Bare Rocky Flats Shells 3-24 (~13 kg HEU) with a Cf-252 source
  - Rocky Flats Shells 3-24 (~13 kg HEU) with a Cf-252 source reflected by 0.5” Fe
  - Rocky Flats Shells 3-24 (~13 kg HEU) with a Cf-252 source reflected by 0.5” W
  - Rocky Flats Shells 3-24 (~13 kg HEU) with a Cf-252 source reflected by 2” HDPE

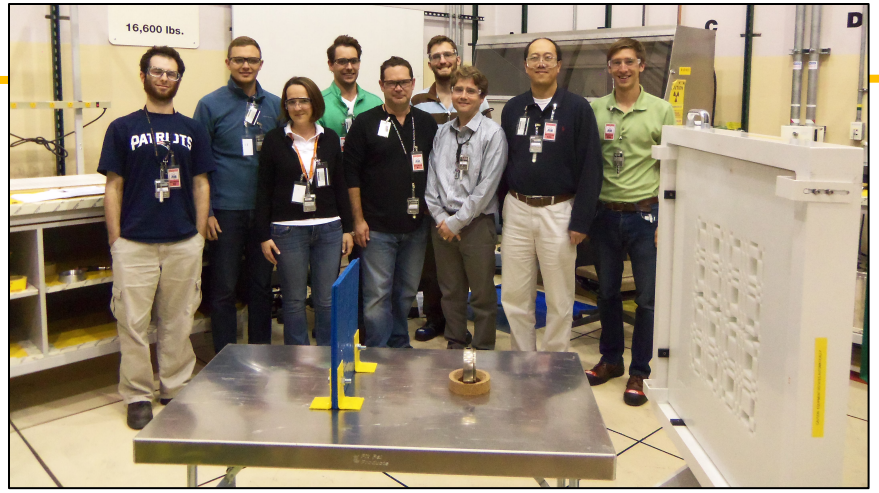
RF shells being reconfigured for the CNEC campaign

CVT measurement campaign

- July 06 – July 09 2015.
- Included students, professors, and staff from UM, NCSU, and ORNL.
- The following detector systems were used:
  - Coded aperture neutron camera
  - Dual-particle neutron and gamma-scatter imager
  - Polaris gamma-scatter imager
  - Orion gamma-scatter imager



CVT measurement campaign



- 12 configurations were measured:
  - Bare BeRP ball (4.5 kg α-phase Pu sphere)
  - BeRP ball reflected with 1.5” HDPE
  - BeRP ball reflected with 3” HDPE
  - BeRP ball reflected with 1” Fe
  - BeRP ball reflected with 0.5” W
  - Bare Rocky Flats Shells 3-24 (~13 kg HEU) driven by AmBe source
  - Rocky Flats Shells 3-24 (~13 kg HEU) driven by AmBe source reflected by 2” HDPE
  - Rocky Flats Shells 3-24 (~13 kg HEU) driven by AmBe source reflected by 0.5” Fe
  - Bare Thor core center (~4 kg δ-phase Pu)
  - Thor core center (~4 kg δ-phase Pu) reflected with 2” HDPE
  - Thor core center (~4 kg δ-phase Pu) reflected with 0.5” Fe
  - Thor core center (~4 kg δ-phase Pu) reflected with 0.5” W

Conclusions

- Both measurement campaigns were very successful.
- Measured configurations included Pu and HEU.
  - Included bare and reflected/shielded configurations.
  - Some configurations used external sources at varying positions to provide imaging challenges.
- This is the first time that a large university measurement campaign has taken place at DAF.
- In addition to providing unique SNM configurations to measure, it also provided students the opportunity to observe work in a nuclear facility and experience experimental work with large quantities of SNM.

Future work

- CNEC and CVT will continue to have measurement campaigns at DAF in years 2-5.
- Year 2 measurements are currently in planning stages.
- The preliminary design will have personnel from NCSU, UM, UIUC, Princeton, NCA&T, and ORNL.
- The year 2 campaign will include ~15 detector systems.
- Active interrogation will be a major focus for year 2 measurements.
- Challenges: requested polyethylene “collimator” exceeds the CEF TSR for combustible loading.

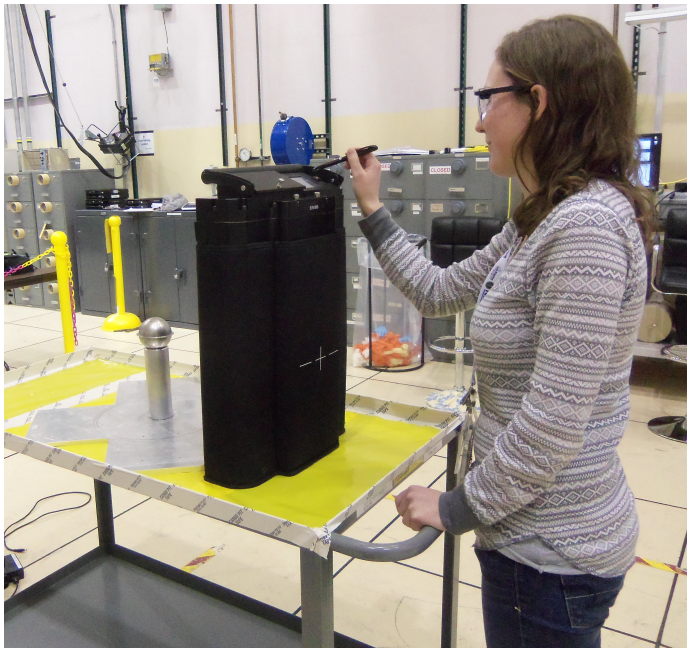
Future work

- Nuclear Science and Security Consortium (NSSC) led by the University of California, Berkeley ended the 5 year project last year.
- NA-22 awarded a second 5 year NSSC program to University of California, Berkeley earlier this year.
- NCERC will be involved in the new NSSC consortium.
  - Focus will be on designing critical experiments to meet nuclear data needs for Modeling and Simulation thrust area.

Berkeley
UNIVERSITY OF CALIFORNIA

Future work

- In addition to the NCERC work, LANL has other involvement in the NA-22 consortia.
- LANL POCs:
  - CNEC – Jeff Favorite
  - CVT – Karen Miller
  - NSSC – Rian Bahran.
- 10 week internship for UM CNEC fellow Jennifer Arthur (with mentors Hutchinson and Bahran).
  - Focus on designing upcoming critical and subcritical measurements.
- Adrian Beard (NCA&T) is also working with LANL on detector simulations.



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